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Survey - Based Study For Common Retention Practices Among Orthodontists In North Macedonia

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Abstract
Background: *Orthodontic therapy always ends with retention to prevent the return of the final occlusal outcome and to maintain the teeth in the correct position after the end of orthodontic therapy. This research aimed to survey retention practices, factors affecting retention protocol and differences regarding retention among orthodontists in North Macedonia.*
Material and methods*: 150 questionnaire copies were distributed by mail or personally to orthodontics in North Macedonia. The survey included 24 single or multiple-answer questions, about retention system, frequently used fixed and removable retainers in certain malocclusions, the duration of the retention period, retainer supervision, instructions for patients, and the need for retention guidelines in order to determine habits and knowledge, and reasons for choosing a particular retention regime.*
Results : *Out of 150 questionnaires, 93 were appropriately filled out and returned, so response rate was 62%. 90% give oral information about retention, only 25% informed their patients both oral and written. The most preferred retainer in maxilla (54%) was vacuum-formed appliance, than removable acrylic plate appliance (41%) and only 9% bonded retainer. In mandible, mostly used are VFR (45%), then acrylic plate appliance (29%), bonded retainers (20%). Dual retention was used more in upper jaw. The retention period was 4 to 5 years or lifelong; the choice of retention device in 77% depended on malocclusion. The reason for the choice of VFR are availability (50,5%), quality (36,56%), low-cost (33,3%). Protocol was influenced by clinical experience (75%), knowledge from residency (58%), courses (56%) and from colleagues (40%). 83% made changes in retention protocol in past years, in appliance time (20%) or in retention period (19%). 95,7% of the surveyed orthodontists believe that general guidelines for retention are needed.*
Conclusions*: The most preferred retainers in North Macedonia were vacuum-formed appliance, than removable acrylic plate appliance and at least bonded retainer. Combination of fixed and removable appliance in mandible were used less than in upper jaw. Reason for choosing was malocclusion. Retention protocols are influenced mostly by the clinical experience. Common retention guidelines are required for most orthodontists.*
Keywords: *retention, survey, orthodontic*

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I. Introduction

Orthodontic therapy, regardless of malocclusion, age or biomechanics, always ends with retention to prevent relapse of the final occlusal outcome and to keep the teeth in proper alignment after orthodontic therapy is complete. Maintaining teeth in their corrected positions following orthodontic treatment can be extremely challenging, because teeth have a tendency to move back towards the original malocclusion as a result of gingival, periodontal, occlusal and growth related factors[1,2,3,4]. Physiologic imbalance of local extrinsic forces, such as lip, cheek and tongue pressures acting on the corrected dentition so the teeth may be in an inherently unstable position[5]. Most of the studies suggest that relapse is caused by the fibrous structures within the supporting tissues of the teeth which require time for reorganization when the appliances are removed. Collagen turnover is probably not the important factor in the etiology of relapse, and other extracellular matrix components may contribute significantly to this process[6].

The necessity of retention phase has even been a debate among orthodontists long time ago[7] and occlusion, apical base[8], canine and molar relationship[9], incisors inclination[10] , neuromuscular balance and lasting unfavorable oral habits are listed as the most important factors.

Nowadays, there is a strong acceptance that a retention phase is crucial for stability of treatment results. Furthermore, lifelong retention is advised in most cases[11]. Parameters such as Angle classification, sex, age, initial crowding, maxillary and mandible incisor proclination, horizontal and vertical growth amounts have not been useful in establishing a prognosis[12], but the need for retention appears to increase with the degree of alignment correction, particularly in the maxilla. Extraction of premolars significantly improved long-term stability of mandible incisor alignment[13]. So, long-term stability begins with the treatment plan.

According to Little, arch length and width decreases after orthodontic treatment and the degree of post-retention anterior crowding is both unpredictable and variable and no pretreatment variables either from casts, clinical findings or cephalometric radiographs before or after treatment seem to be useful predictors[14].

Unwanted tooth movements after treatment can also occur as a result of normal age changes. Retainers are therefore indicated not only to resist the tendency of teeth to return to their pretreatment positions, but also to resist unwanted long-term age changes[2] .

There are many variations in retention strategies, durations, materials or individual patient factors which are a challenge for choosing retention. But still there is no consensus regarding the optimal appliance and/or ideal protocol. The type of retention regime and protocol depends on many factors, including but not limited to clinician experience and preference, the type of orthodontic movement achieved, occlusal outcomes and patients age and preferences[3]. There is no evidence to suggest that the retention regimen for adults should differ from that used for adolescents, providing the supporting periodontal tissues are healthy.

Recent years a number of clinical trials have tested retainer wear, protocols and effectiveness. There have been several survey-based studies on this topic, conducted in Australia and New Zealand[15], Netherlands[16,17], United Kingdom[18], United States[19], Norway[20], Ireland[21], Switzerland[22], Saudi Arabia[23], Lithuania[24], Croatia[25], Canada[26]. Results from these studies confirm certain similarities between the countries for the necessity and type of retention devices, but show disagreements about duration, follow-up and need of common protocol[20].

The aim of this study is to examine the clinical practice and retention protocol among Macedonian orthodontists. In addition, to determine specific data on the socio-demographic status of the respondents, the choice of retention system, frequently used fixed and removable retainers in certain malocclusions, the duration of the retention period, retainer supervision, instructions for patients, and the need for retention guidelines in order to determine habits, knowledge and retention regime.

II. Material And Methods

For this research, 150 questionnaire copies were distributed by mail or personally to orthodontics in RNM in period of 6 months (December 2023 to May 2024). 93 questionnaires were appropriately filled out and returned (response rate 62%), which is 48% of total number of orthodontists in RNM. The questionnaire consisted 24 single or multiple-answer questions, clustered in six parts: (1) general information (gender, age, place of residency program, years of practicing orthodontics, main work location, days in working week), (2) information provided to the patients before and after treatment, (3) most commonly used type of retainers and retention appliances applied in different clinical situations, (4) main reason for choosing a certain retention appliance and factors for changes in protocols, (5) duration of retention and manufacturing of retention devices (6) retention supervision and need for common retention guidelines. Our questionnaire allowed the responders to give multiple answers to many of the questions, which made the total exceed 100%.

Percentages, frequencies and X^2-test were used to analyze the data. Commercial statistical software was used (IBM SPSS, IBM co, Armonk, US).

III. Results

The analyses were conducted from 93 completed and returned samples. 75% of responders (70) were female, and 25% (23) male. All of them were between 32-64 years of age (median 45). 93% of them (87) attended an orthodontic residence program in the Faculty of dentistry, UKIM in Skopje, only 7% (7) acquired qualifications in Faculty of dentistry, UGD in Stip. Mostly of them (88%) practiced orthodontics mainly for 5 days per week. Years of work experience were from 1 to 35 years orthodontic practice (median 12) and did not differ between genders. Majority (62%) have orthodontic experience more than 10 years. Two thirds of them work in private practice (table 1).

The majority of orthodontists (90%) give oral explanations and information about retention, at the beginning of orthodontic treatment. Only 25%, mostly from younger age and from private dental offices, informed their patients both oral and written. More then half of them (59%) inform patients about the type and

duration of retention and give hygiene instructions. At the end of treatment 95% give oral information regarding the need for retention, 51% about caution and problems, 52% about interdental brush, 33% about electric brush, 32% for flossing the teeth, and only 23% give info for tooth pick (table 1).

Table 1. sex, working place, years of experience and information about retention procedures

Variable	prevalence
Invited	150
Respondents	93 (62%)
female	70 (75%)
male	23 (25%)
Working experience	
< 10 years	36 (38%)
< 10 years	57 (62%)
Days a week in clinical practice	
5	82 (88%)
4	1 (1,3%)
3	7 (7,5%)
2	3 (3,2%)
Main work location	
private practice	71 (76,4%)
public practice	12 (12,9%)
university	9 (9,67%)
Giving oral info at the beginning of orthodontic treatment about retention	84 (90%)
Written info	23 (25%)
Retention type info	55 (59%)
Retention duration info	55 (59%)
Giving oral info at the end of orthodontic treatment about retention	88 (95%)
Written info	18 (19%)
Info on caution and problems	47 (51%)
Info on interdental brush	48 (52%)
Info on tooth pick	21 (23%)
Info on floss	30 (32%)
Info on electric brush	31 (33%)

The most preferred retainer in maxilla (54%) was vacuum-formed appliance (VFR), than removable acrylic plate appliance (41%) and only 9% bonded retainer. Combination of fixed and removable appliance used only 19% of orthodontists. Percentages are a little different for mandible. Most commonly used are VFR (45%), then acrylic plate appliance (29%), bonded retainers (20%). Combination of fixed and removable appliance was used less than in upper jaw (15%). Most of respondents bonded a fixed retainer in the lower jaw to all six anterior teeth and was made and placed by the orthodontists (99%). Overall, most used removable retainer was the thermoplastic retainer for younger part of responders, with less than 10 years of experience, and acrylic plate retainer was more often used by more experienced orthodontists (table 2).

Table 2. Most commonly used retention appliances in both jaws

Variable	prevalence
Maxilla acrylic plate retention	38 (41%)
Maxilla VFR	50 (54%)
Maxilla only fixed	8 (9%)
Maxilla combination fixed + removable	17 (19%)
Mandible acrylic plate retention	27 (29%)
Mandible VFR	42 (45%)
Mandible only fixed	19 (20%)
Mandible combination fixed + removable	14 (15%)

Table 3 shows the frequency of use of retention appliances in the maxilla and mandible according to different irregularities. A combination is most often used in extraction cases and spacing; mobile devices or a combination are most often used after arch expansion and open bite treatment. Only the bonded retainer is the mostly commonly used for spacing and rotated teeth.

Table 3. Retention appliances applied in different clinical situations (according to type of malocclusion)

	Maxilla			**Mandible**		
	Bonded	Removable	Combination	Bonded	Removable	Combination
Extraction	21 (22,5%)	25 (26,8%)	46 (49,5%)	23 (24,7%)	23 (24,7%)	45 (48,4%)
Spacing	32 (34,4%)	19 (20,4%)	42 (45,2%)	34 (36,56%)	17 (18,3%)	40 (43%)

	Maxilla			**Mandible**		
Frontal expansion	6 (6,45%)	46 (49,5%)	41 (44%)	9 (9,7%)	40 (43%)	44 (47,3%)
Lateral expansion	5 (5,37%)	47 (50,5%)	41 (44%)	9 (9,7%)	39 (42%)	45 (48,3%)
Impacted canines	29 (31,2%)	28 (30%)	17 (18,3%)	31 (33,3%)	22 (23,6%)	40 (43%)
Rotated teeth	26 (28%)	28 (30%)	40 (43%)	34 (36,56%)	19 (20,5%)	39 (42%)
Open bite	14 (15%)	37 (39,8%)	41 (44,1%)	21 (22,6%)	34 (36,6%)	37 (39,8%)

Two thirds of respondents practice retention of 4 to 5 years or lifelong. 38,7% preferred permanent retention. Majority arranged 4 or 5 check-ups in first year with removable and 2 to 4 times for bonded retainer. Re-calls are up to three times thereafter. The orthodontist's years of experience or weekly work with patients were not associated with the duration of retention or number of check-ups during first and following years (table 4).

99% do the retention monitoring by themselves and very rarely leave the monitoring to general dentist or to the patients themselves. 95.7% of surveyed orthodontists believe that there should be a general retention guidelines. Almost all orthodontists place the bonded retainer themselves, while mobile retainers are made by a technician. 83% made any changes in retention protocol in past years, in appliance time (20%) or in retention period (19%). The reason for the choice of VFR are availability (50,5%), quality (36,56%), low-cost (33,3%). As additional reasons, the respondents indicated hygiene, esthetics, comfort, experience, patient's wish. This is also confirmed by the fact that if a break happens, a new VFR is often made. (table 4).

Table 4. Duration of retention and monitoring; use of VFR and change in protocols

Variable	prevalence
Duration of retention period	
1 yrear	2 (2,15%)
2 years	11 (11,8%)
3 years	8 (8,6%)
4 years	14 (15%)
5 years	22 (23,65%)
for life	36 (38,7%)
Appointments in retention period	
in first year for mobile retainer	
1	6 (6,45%)
2	10 (10,75%)
3	17 (18,3%)
4	27 (29%)
5	26 (28%)
6	6 (6,45%)
in first year for bonded retainer	
1	11 (11,8%)
2	27 (29%)
3	15 (16%)
4	19 (20,4%)
5	16 (17%)
6	2 (2,15%)
thereafter	
once	20 (21,5%)
twice	34 (36,6%)
3 times	14 (15%)
4 times	17 (18,3%)
5 times	4 (4,3%)
Monitoring after 3 years in retention	
orthodontist	92 (99%)
dentist	1 (1%)
patient	0
Is it necessary to have general guidelines for retention	
yes	89 (95,7%)
no	2 (2,15%)
don't know	2 (2,15%)
What is main reason for choice of VFR?	
availability	47 (50,5%)
cost	31 (33,3%)
quality	34 (36,56%)
recommendation	11 (11,8%)

other (hygiene, esthetics, comfort, experience, patient's wish)	13 (13,9%)
don't use	2 (2,15%)
Using VFR, what is mostly used thickness of the material	
0,75 mm	4 (4,3%)
1mm	54 (58%)
>1 mm	29 (31,2%)
don't know	4 (4,3%)
Changed the kind of VFR in last year	
yes	6 (6,45%)
no	59 (63,4%)
don't know	28 (30,1%)
Main reason for change VFR type	
availability	10 (10,75%)
cost	4 (4,3%)
quality	10 (10,75%)
recommendation	4 (4,4%)
other	65 (69,8%)
For how long you assume the VFR last before it is worn out	
< 1 year	27 (29%)
up to 2 year	42 (45%)
> 2 years	13 (14%)
don't know	11 (12%)
How many patients get new VFR because is worn out / fractured	
10%	30 (32,25%)
10-25%	32 (34,4%)
25-50%	8 (8,6%)
>50%	10 (10,75%)
Don't know	13 (14%)
Have you register adverse effects / allergic reactions related to VFR wear	/
What kind of effect has been registered	/
Changes made in any kind of retention protocol	77 (83%)
Change in appliance type	19 (20%)
Change in retention period	18 (19%)

As reasons for choosing the retention appliance and protocol, from the most frequent to the rarest, were malocclusion (77%), treatment outcome (57%), age/completion of growth (42%), oral hygiene and periodontal health (40%), myofunctional status (31%) patient wish and motivation (30%), wisdom teeth (23%) and tooth morphology (9%) (table 5).

For all sample, selection of protocol was mainly influenced by clinical experience of the orthodontists (75%), acquired knowledge from their educational programs (58%), knowledge gained from courses (56%) and from colleagues (40%). For younger orthodontists, those with less than 10 years of experience, main reasons for choosing a protocol were knowledge and skills gained in their orthodontic residency. Other ones, with more than 10 years in practice, choose "clinical practice" as main factor (table 5).

Table 5. reasons for choosing retention protocol and factors influencing the decision for retention protocol in use

Variable	prevalence
Retention choice - malocclusion	72 (77%)
Retention choice – treatment outcome	53 (57%)
Retention choice – oral hygiene	37 (40%)
Retention choice – periodontal health	37 (40%)
Retention choice – patient's wish and motivation	28 (30%)
Retention choice – age/completion of growth	39 (42%)
Retention choice – myofunctional status	29 (31%)
Retention choice - tooth morphology	8 (9%)
Retention choice – wisdom teeth	21 (23%)
Retention choice – info from residency	54 (58%)
Retention choice - experience	70 (75%)
Retention choice - literature	47 (51%)
Retention choice - courses	52 (56%)
Retentnion choice - colleagues	37 (40%)

IV. Discussion

Nowadays, there is a strong acceptance that a retention phase is crucial for stability of treatment results. Furthermore, lifelong retention is advised in most cases[11]. The method of retention is best selected at the outset of treatment and incorporated in the treatment plan for that particular case. Generally, there are two types of retainers: a removable and a fixed. They can further be classified into temporary, semi-permanent and a

permanent retainers, which assists in achieving a balance between the muscular forces of the lips, cheeks or tongue and the forces of occlusion. The retainer should be noninvasive and well tolerated by the patient with minimal negative effects on speech, mastication, oral hygiene, comfort and the general health of the oral tissues.

The orthodontic literature shows wide discussions on retainers, especially concerning their indication, type of appliance and time they should be maintained after completion of active orthodontic treatment. All studies without exception confirm the need and effectiveness of retentional devices and protocols**.** Most of the researches are focused on the lower anterior crowding relapse[27]. Longer retention periods, particularly in the mandible, lead to better tooth alignment than shorter ones[28,29]. Sometimes are used adjunctive procedures to try to improve retention, for example, interproximal reduction (reshaping teeth where they contact) or precision (cutting fibres around teeth).

Despite the fact that many surveys of retention trends and protocols which have been conducted in different countries have revealed some tendencies between the orthodontists, the topic is not yet closed and additional research is still needed. In current study, the survey questionnaire was developed according to similar studies. The response rate was 62%, relatively consistent with surveys conducted in other countries; 75,7% in Lithuania[24], 57% in Australia and 60% in New Zealand[15], 61,3% in Croatia[25], 62% in Scandinavian countries[30], 65% in Switzerland[22]. But only 18% was response rate in Canada[26] and same in international survey among 3000 participants from Asia, Europe and Africa[31]. Overall, response rate of 60% is suggested as level of adequacy[32].

In our survey 75% were female; 38% were with less than 10 years experience, and 62% with up to 35. But this demographic differences didn't affect the choice of retention protocol. All respondents used retention after ending of active orthodontic treatment and inform patients about retention at the beginning of treatment, most of them (90%) orally, and only 25% in writing. The majority (59%) brief them about the type and duration of retention. There is a higher percentage of information at the end of the active treatment, mainly about possible problems and maintaining hygiene. These results indicate that orthodontists are aware that retention and the potential for relapse must be a key part of the informed consent process prior to orthodontic treatment. It is vital for patients be fully aware of their responsibilities in committing to wear retainers as prescribed in order to reduce the chance of relapse, without exceptions. Otherwise, they must be prepared to accept that there will be tooth positional changes. An important aspect of informed consent for orthodontic treatment is the need for the patient to fully understand the long-term risk of relapse, and appreciate the procedures to minimize the risk. So "retainers must be wear for as long as patient want straight teeth"[3].

The most used retention device in both jaws is the VFR, probably due to its availability (50,5%), quality (36,5%) and price (33,3%). Acrylic-plate retainer prefers 41% in maxilla and 29% in mandible, especially after the expansion of the dental arches. The bonded retainer is used more in the lower jaw than in the upper one (20% and 9% respectively). Combinations of fixed and mobile retainers are used to, often in the mandible. Our results for maxilla are similar to Australian and New Zealand[15] results and in international survey[31].

The most common examples of removable retainers were thermoplastic than acrylic-plate retainers. Patients prefer the appearance and comfort of thermoplastic retainers which are more cost-effective and slightly more effective in maintaining stability, particularly in the lower arch[33,34]. In Sweden, removable maxillary retainers were significantly more frequent[30] , similarly as in North Macedonia. In Malesya[35] and Ireland[21] only VFR. Studies from other parts of the globe showed different outcomes. For instance, in USA[36,19] and Saudi Arabia[23] the Hawley retainer was the most common maxillary retention appliance. For maxilla, Norwegian[20] and Switzerland[22] practitioners prefer dual retention.

The VFR are removable thermoplastic retainers and were introduced by Ponitz in 1971 and further developed by Sheridan. In the literature, the terms 'vacuum-formed retainer, 'thermoplastic retainer', 'drawn down retainer', 'vacuum retainer', 'Essix retainer', '(clear) overlay retainer', 'invisible retainer' and '(clear) slipover' appear to be interchangeable. They are made from co-polyester (more aesthetic, but tends to crack and fracture more easily) or from polypropylene or ethylene co-polymer (more resilient, but less retentive)[37]. They are relatively inexpensive, aesthetic, comfort perspective and can be quickly fabricated. They are mostly used by orthodontist in Australia[15], UK[18] and Ireland[21] and become more popular among members of the American Association of Orthodontists in the United States[36].

The popularity of VFR is increasing in our country, which is in accordance with other national surveys. The main reasons for the selection are availability, quality, low-cost. As additional reasons, the respondents indicated hygiene, esthetics, comfort, experience, patient's wish. This is also confirmed by the fact that if a break happens, a new VFR is often made.

Possible disadvantages include: compromised retention in patients with hyperplasic gums; breakage and poor wear resistance; possible inability to maintain expanded arches or alignment of previously severely rotated or displaced teeth due to its lack of rigidity; inhibition of any desired vertical 'settling-in' of the occlusion subsequent to active orthodontic treatment; potential for demineralization, caries and poor gingival

health if a careless dietary lifestyle with frequent 'fizzy' drinking take is adopted; reliance on patient compliance[37].

Outhaisavanh and coworkers[38] found that wearing VFR provides better relapse prevention of incisor irregularity than Hawley retainers in both arches, indicating their usefulness in clinical practice. But, there is no evidence that the pattern of time duration wearing, provides excellent stability. It has been shown in many cases, that removable retainers need only be worn at night to maintain dental stability[39,40,41]. In 2016 the updated Cochrane systematic review concluded that it is still unclear which retainers are the best and how long they should be used, and there is no evidence that full-time wearing of retainers provides greater stability than wearing them part-time[42].

Based on research of six randomized controlled trials, Li and associates confirmed that patients with Hawley retainer had better periodontal health compared with those using vacuum-formed retainers[43]. Examination of periodontal pathogens and periodontal status within 6 months of wearing three types orthodontic retainers, reveal that the Hawley retainer was superior to vacuum-formed retainer and lingual fixed retainer with regard to Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans and periodontal clinical parameters (gingival index, plaque index and probing depth)[44]. Other study found no statistically significant difference in salivary Streptococcus mutans and Lactobacillus casei levels in patients with same retention devices[45].

None of the respondents in our study reported adverse effects, in the Scandinavian study it was 1%[30]. There is only one retrospective analysis of the Manufacturer and User Facility Device Experience database of FDA which confirms that side effects with Invisalign foils can occur, like difficulty breathing, itchiness, swollen throat, tongue or lips[46].

On second place in terms of popularity in our country is bonded, fixed retainer which was first introduced in 1973 by Kneirim[47] and since than it has been used as integral part of orthodontic treatment, because removable plates in mandible have a large bulk of acrylic lingually, decreasing the tongue space, impairing swallowing and speech.

In Norway, bonded retainers alone were reported to be most commonly used in the mandible, while bonded retainers in combination with a removable retainer appear to be the most commonly used appliances in the maxilla[20]. Similarly is in Macedonia.

There are a lot of similarities noticed when comparing findings from previously published data in the literature. Bonded retainer in mandible is commonly used in USA[19,36], Norway[20], Switzerland[22], Saudi Arabia[23], Netherlands[16,17], Croatia[25], Australia and New Zealand[15], Canada[26] and in Ireland[21] alone or in combination with VFR.

Now, fixed retainers are commonly used in the orthodontic retention phase as they have a number of advantages, such as effectiveness, better aesthetics, no need for patient cooperation and suitability for lifelong retention[48] and can be associated with a non-mechanical process such as surgery (e.g., fibrotomy). They are discrete and reduce the demands on patient compliance[2]. The bonded orthodontic retainers constructed from multi-strand or steel wires of different sizes and shapes, or composite had the slightly elastic properties which allow a physiologic mobility of the teeth, so can be maintained long-term[49].

But, some of their drawbacks are their need for precise bonding technique, fragility and propensity to cause periodontal problems by deteriorating oral hygiene, placement method is time-consuming and technique-sensitive[50]. However, fixed retainers are associated with several limitations, notably a high percentage of related failures (fractures, debonding) mainly in the maxilla (23-58%) compared to the mandible (5-37%)[51]. Scheibe and Ruf[52] reported that almost 30% of patients experienced retainer failure within 30 months and 17% have total retainer loss. Egli and coworkers[53] found no difference in the risks of failure between mandibular retainers bonded with direct and indirect methods.

Additionally, calculus and plaque deposition is greater than in removable ones, so concern about long-term dental health is justified and patients must be provided with clear instructions on oral hygiene. Effective oral hygiene and follow-up regimens remain the gold standard in maintaining periodontal health and preventing gingival recession[54]. Opinions regarding the recession are divided, but it is more prevalent in older than in younger patients and no variable, except for age at the end of treatment, seems to be associated with the development of gingival recessions[55]. An important consideration is that recession could be a late finding and therefore, may be absent in short-term evaluations[54].

One retrospective, longitudinal cohort study confirm that long-term presence of fixed lingual retainers does not seem to increase the development of mandibular gingival recession, but does increase calculus accumulation[56]. Recent clinical trial reveal that young patients with fixed steel retainers show in 73.3% healthy gingival conditions after one year which are comparable to the control group (88.2%) and gingival recessions were in a clinically non-relevant range[57].

Cases where fixed retention may be preferred are : correction of severely rotated or impacted teeth, cases with reduced periodontal support, closure of a spaced dentition or creation of space prior to prosthodontic

management and in cleft lip and palate patients with evidence of severe post-surgical scarring that may predispose to relapse[3]. Our results in the selection of the retention device are in agreement with this.

New opportunities have arisen to manufacture 3D retainers by digital cutting technology[58]. A scientists from Aachen, concluded that there is a high level of congruence between the 3D virtually planning and the final intraoral position of the fabricated novel 3D CAD/CAM titanium retainers[59].

In some instances, clinicians choose to use a combination of fixed and removable retainers in a process referred to as 'dual' retention. The patient is fitted with a fixed retainer, and is provided with a removable retainer to wear at night as a back-up[2,3].

Indefinite retainer wear was commonly suggested by Canadian orthodontists and was significantly influenced by the number of years in practice[26]. 38,7% from our survey are on this attitude.

Experience, training background, dental care delivery and oral health attitude are the most influential on common retention trends in literature, or only compliance of the patients and status of oral hygiene[31]. Pre-treatment crowding, spacing and degree of rotation were the most influencing malocclusion related factors.

In our survey, the original malocclusion was reported to be the most important factor influencing the choice of retention type (77%) then treatment outcome (57%), age/growth completion (42%), oral hygiene and periodontal health (40%), patient's wish and myofunctional status and parafunctions (30%). just as in Australia and New Zealand[15], Norway[20], Croatia[25] and the Netherlands[16]. Furthermore, 75% of orthodontists in Macedonia listed that protocol was mainly influenced by clinical experience. But, an important reason for the selection are residency (58%), courses too (56%), literature (51%) and colleagues (40%). Our orthodontists with less than 10 years of experience used a protocol based on the skills learned during their residency, while orthodontists with more than 10 years of experience practiced retention regime based on their orthodontic work ($p < 0.05$). Almost of the participants agreed that professional guidelines on retention would be useful.

In Cochrane Database Syst Rev, there cannot be drawn firm conclusions about any one approach to retention over another, in 47 studies that examine removable vs fixed retainers, different types of removable or fixed retainers, or bonding materials[60].

There is a lack of high-quality evidence to endorse the use of one type of orthodontic retainer based on patient-reported outcomes and cost-effectiveness and their effect on periodontal health and failure risk[61].

V. Conclusion

The most preferred retainers in North Macedonia are vacuum-formed appliance (VFR), than removable acrylic plate appliance and at least bonded retainer. Combination of fixed and removable appliance in mandible was used less than in upper jaw. Retention method must be individualized, taking into account a orthodontic malocclusion, treatment outcome, completion of growth, periodontal health and expected level of patient compliance. Retention protocols are influenced mostly by the clinical experience.

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